

# TEAMING AND INNOVATION TO CREATE A 1,3W COST POWER SUBSYSTEM FOR THE MARS MICROROVER

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## ABSTRACT

Small, low-cost missions are typically constrained by mass, budget and schedule restrictions to a point where painful decisions and trade-offs inevitably arise. In these situations, the descope options frequently threaten subsystem reliability and capability. The power subsystem on JPL's Mars Microrover has attempted to mitigate the hazards of low cost subsystem development by emphasizing teaming and innovation.

The Rover mission begins at Mars arrival in July 1997. The six-wheeled semiautonomous vehicle has a primary mission of seven days on the Martian surface performing science and technology experiments, with an extended mission capability of up to many months. To accomplish its objectives, the Rover requires a scaled down version of a full spacecraft power subsystem, including a solar array, a primary battery, and power conditioning hardware. The total life cycle budget for the subsystem is \$1800K, includes design, fabrication, testing, and operations. Subsystem mass is restricted to approximately 2.1 kg.

Despite limited resources, much of the capability of a larger more costly power subsystem was recaptured by an emphasis on teaming across traditional boundaries and by encouraging innovative approaches. Work between the power subsystem and mechanical subsystem resulted in a light-

weight packaging scheme for the battery that maximizes use of the existing mechanical structure. The lithium thionyl chloride cells are expected to deliver as much as 360 Whrs on Mars with a total battery weight of 1.2 kg. A similar teaming arrangement integrated the power distribution and management components with computer control and navigation hardware. A total of 11 user voltages are generated from an unregulated main power bus operating between 8 and 18 volts. The single string configuration allows for graceful degradation due to failures.

The teaming approach also carried over into the contracting process. Procurement costs for the Rover's relatively small gallium arsenide solar array were reduced by combining the contract with the larger Pathfinder spacecraft array procurement. Lower unit costs allowed the project to build a full scale test panel to prove out the fabrication process, perform initial system integration, and develop operational scenarios. Test equipment, ground support equipment, and operational simulation hardware were combined to minimize costs. This effort also resulted in an improved capability over larger flight project support equipment suites and generated two new technology concepts: a high fidelity, flexible, low cost solar array simulation technique and a new method for measuring solar array health using cell capacitance.